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IMPROVING THE PERFORMANCE OF CASCADED H-BRIDGE BASED INTERLINE DYNAMIC VOLTAGE RESTORER

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ABSTRACT

A Dynamic Voltage Restorer (DVR) model is designed for voltage compensation and is tested for distribution system to improve Power Quality (PQ). The design is based on an integration of Voltage Source Inverter (VSI) in the application of DVR.

The testing results have been presented in this paper to analyze the performance of VSI with Sinusoidal Pulse Width Modulation (SPWM) control technique.

INTRODUCTION

The increasing demand of power and its utilization has been grown up in recent years, which necessitates continues power supply to the consumer. Irrespective of the type of consumer, that is a consumer from an industry, corporate, public & government sector, hospitals, agriculture, domestic etc. everyone needs an un-interrupted power supply. However, the consumer may not worries about the PQ issues like transients, voltage sag, swell, interruption, under voltage, over voltage, harmonics, flicker etc. unless they aware that one of these issues may causes the damage to their equipment. For instance, voltage sag may affect the manufacturing process of the semiconductor industry and a voltage swell may damage the sensitive electronic appliances like televisions. A variation in the frequency may give the problem to the oscilloscopes used in medical applications at hospitals and flicker may results in an irritation to the eyes.

If the consumer is un-aware of these things, it is the responsibility of the power supplier to make them aware of the PQ issues and their affects. Otherwise, the consumer should have taken the precautions to avoid the damages that occur due to these PQ issues. Since, it is required to provide a solution to these PQ problems a custom power device like DVR is needed at distribution level. The dynamic voltage restorer (DVR) is a series custom power device intended to protect sensitive loads from the effects of voltage sags at the point of common coupling (PCC). A typical DVR connected system circuit is shown in Fig. 1, where the DVR consists of essentially a series connected injection transformer, a voltage source inverter (VSI), inverter output filter and an energy storage device connected to the dc-link.

The power system upstream to DVR is represented by an equivalent voltage source and source impedance. The basic operation principle of the DVR is to inject an appropriate voltage quantity in series with the supply through an injection transformer when PCC voltage sag is detected. Loads connected downstream are thus protected from the PCC voltage sag. The performance of a DVR is determined solely by its controller. The design of high performance control algorithms for DVR control with improved robustness and steady-state and transient performances is therefore an important area of study.

PROPOSED SYSTEM

A Dynamic Voltage Restorer (DVR) model is designed for voltage compensation and is tested for distribution system to improve Power Quality (PQ). The design is based on an integration of Voltage Source Inverter (VSI) in the application of DVR.

The testing results have been presented in this paper to analyze the performance of VSI with Sinusoidal Pulse Width Modulation (SPWM) control technique.

VOLTAGE COMPENSATION IN DISTRIBUTION SYSTEM

A. WORKING OF DVR:

A DVR is a custom power device in conjunction with the Voltage Source Inverter (VSI) which injects the voltage in series with the power distribution system through a Series Injection Transformer (SIT) during voltage sag. A schematic diagram of DVR connected in a distribution system. The energy source required for DVR can also draw from the source supply through a bridge rectifier, which would, made this design a cost effective model.

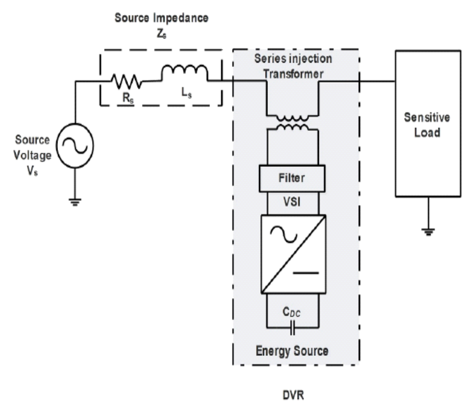

Fig: Schematic diagram of a DVR connected distribution system.

In practice, the voltage sag occurs in the distribution level is in the range of 50% to 90% and most voltage sags rarely reach below 50% [1]. However, the capability of voltage compensation by DVR system is above 50% of the nominal voltage, thus it allows DVRs to attain protection against voltage sags of 50% for the duration of up to 0.1 seconds.

A single line diagram of a DVR compensated system to protect the sensitive load against the voltage sag is described. In this compensation system the DVR is represented by an ideal voltage source which injects a voltage *VDVR* in series with the terminal voltage *Vt* in the direction shown. It also can be noted that the source current *is* is same as the load current *il*.

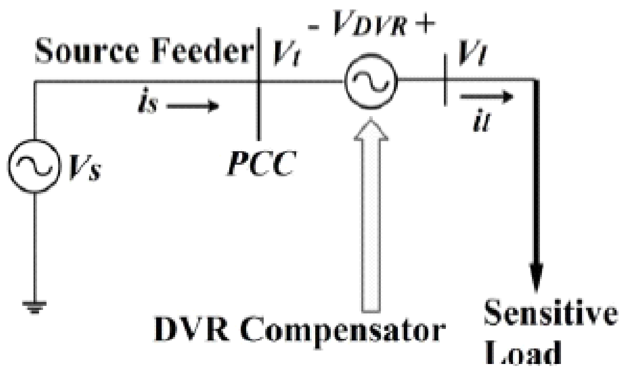

Fig: Single line diagram of a DVR connected compensation system

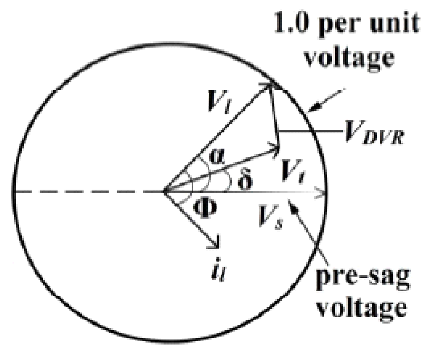

Fig:3.3 Phasor diagram of a power distribution system during voltage sag.

B. VOLTAGE COMPENSATION BY DVR USING VSI:

When a voltage sag occurs in the line connecting to a sensitive load, the voltage to be compensated can be injected to the load bus by DVR with the use of VSI. However, it is important that the VSI should be capable to generate the required voltage to be injected through SIT. Also, the voltage level generated by the VSI should be controllable so that it should generate only the required magnitude of the voltage to be compensated. The proposed DVR compensation system is adopted with the VSI which is controlled by a Sinusoidal Pulse Width Modulation (SPWM) control technique.

C. SPWM GENERATION USING NI-MYRIO 1900

The most common and reliable PWM technique used in many power electronics applications which are usually working with the VSI is SPWM control technique. Though there are many advanced control techniques available [4], this paper is limited to SPWM only because of experimental implications. The Fig.4 shows the SPWM pulses obtained by comparing a sinusoidal wave of 50 Hz frequency with a triangular wave of 5 kHz frequency. The sampling frequency of the carrier wave that is triangular in this case, can be increased to get lower harmonic content in the inverter output voltage.

D. LOW PASS FILTER DESIGN:

A simple low-pass filter is designed with the components of resistor RF, an inductor Lf and a capacitor Cf for the sampling frequency of 5 kHz. Also, the filter design is experimentally tested with the various values of filter components to get a pure sine wave with lower harmonic components. The VSI output voltage Vinv is applied to the filter circuit and the voltage available across the capacitor Cf can be considered as VDVR which is to be injected in series to the load bus during voltage sag.

CONCLUSION

The voltage compensation levels were observed accurately and the line voltages were restored during the sag period precisely since the SPWM pulses were generated at a higher frequency of 5 kHz, thus improves the power quality.

The results have been presented along with the observations obtained from the experiments conducted and the design of DVR found effective at a lower cost.

The DC source required for DVR is taken from the line itself through a rectifier circuit, there may be a power reversal problem if the phase angle of the load voltage leads the line voltage.

REFERENCES

[1] T. Noguchi, H. Tomiki, S. Kondo, I. Takahashi "Direct Power Control of PWM Converter Without Power-Source Voltage Sensors" IEEE Transaction on Industry Applications, Vol. 34, No. 3, May/June 1998, pp. 473-479.

[2] IEEE Standard 1159-2009: "Recommended Practice for Monitoring Electric Power Quality."

[3] William E.Brumsickle, Robert S. Schneider, A.Luckjiff, Deepak M.Divan and